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NAVAL RESEARCH LABORATORY
MATERIALS SCIENCE AND TECHNOLOGY DIVISION
PHYSICAL METALLURGY BRANCH

SEMINAR ANNOUNCEMENT

Wednesday, 5 September 2001

10:30 AM

BUILDING 28 / ROOM 269 (6300 Division Conference Room)

**“Ductile, Machinable Ternary Carbides and Nitrides:
A New Class of Solids”**

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During the past 5 years we identified three classes of layered, hexagonal ternary carbides and nitrides with the general formula: $M_{N+1}AX_N$, where $N = 1$ to 3 , M is an early transition metal, A is an A-group (mostly IIIA and IVA) element and X is either C and/or N. We have called these the MAX phases. In all of these compounds, XM_6 layers are separated from each other by layers of pure A. These carbide and nitrides, which total over 60, represent a *new class of solids: thermodynamically stable nanolaminates*: a hitherto unknown and uncharted category of solids with unique chemical, physical, electrical and mechanical properties. They combine the best attributes of metals and ceramics. Like metals, they are electrically and thermally conductive, most *readily machinable*, not susceptible to thermal shock, plastic at high temperatures, and exceptionally damage tolerant. In the case of Ti_3SiC_2 also creep, fatigue and oxidation resistant. Like ceramics, they are elastically rigid, lightweight, and most important, maintain their strength to temperatures that render the best of today's superalloys *unusable*. With proper alignment of the grains, they are ductile at ambient temperature. Three interrelated characteristics distinguish these phases from other layered materials: i) the metallic-like nature of the bonding; ii) basal slip, and *only* basal slip, is operative down to at least 77K and, iii) they deform by a unique combination of kink and shear band formation together with delaminations. The technological implications of having these naturally nanolayered materials will be discussed.

Biography: Professor Michel Barsoum is a Distinguished Professor of Materials Engineering at Drexel University. Dr. Barsoum received his B.Sc. in Materials Engineering from the American University in Cairo, Egypt in 1977; his M.S. from University of Missouri-Rolla, Rolla, MO, in 1980, and his Ph.D. in Ceramics from the Department of Materials Engineering at the MIT in 1985. Dr. Barsoum's current research interests, among others, focus on developing and characterizing ceramic based materials for very high temperature applications. Dr. Barsoum and his research group were the first to fabricate, fully characterize an important new class of machinable ternary carbides and nitrides. Since 1997, Dr. Barsoum and his collaborators have published over 60 refereed papers on these ternary carbides and nitrides including ones in Nature and Science. He is the author of the textbook, *Fundamentals of Ceramics*, McGraw Hill, NY, 1997. Dr. Barsoum has authored or co-authored over 100 publications (80 refereed), has 5 US patents awarded and 2 pending. In 2000 he was awarded a Humboldt-Max Planck Research Award for Senior US Research Scientists and spent his sabbatical year at the Max Planck Institute in Stuttgart.

Visitors to this talk are welcome. Please see the receptionist at the Security Office (Bldg. 72) before entering NRL. For further information please call Dr. Khershed P. Cooper, 202-767-0181.

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